APPLICATION FOR RADIOACTIVE MATERIAL LICENSE
MEDICAL

INSTRUCTIONS – Complete all items in this application to apply for a new license or the renewal of an existing license. Use supplemental sheets where necessary. Item 31 must be completed on all applications. Mail to: Washington State Department of Health, Division of Radiation Protection, PO Box 47827, Olympia, Washington 98504-7827. Upon approval of this application, the applicant will receive a State of Washington Radioactive Material License issued in accordance with the general requirements contained in Washington State Department of Health, Radiation Protection Regulations, and the Washington Energy and Radiation Control Act, Chapter 70.98 RCW.

1a. NAME AND MAILING ADDRESS OF APPLICANT (Institution, Firm, Clinic, Physician, etc.) **INCLUDE ZIP CODE**	**1b. STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED** if different than 1a. **INCLUDE ZIP CODE**
2. PERSON TO CONTACT REGARDING THIS APPLICATION	**TELEPHONE NO.** ( ) _____ - _____ **FAX NUMBER** ( ) _____ - _____ **EMAIL ADDRESS**
3. THIS IS AN APPLICATION FOR: (check Appropriate item) **A. ❑ NEW LICENSE B. ❑ AMENDMENT TO LICENSE NO. WN-M _____ C. ❑ RENEWAL OF LICENSE NO. WM-M_____**	
4. INDIVIDUAL USERS (If more than one will be named, complete "Authorized Use" Form)	**5. RADIATION SAFETY OFFICER (RSO)** (Name of person designated as Radiation Safety Officer).

6a. RADIOACTIVE MATERIAL FOR MEDICAL USE

Radioactive Materials ad defined in WAC 246-235-120 Schedule A	ITEMS DESIRED MARK "X"	MAXIMUM POSSESSION LIMITS (in curries)	Particular procedure desired where Groups IV and V are **NOT** checked.	ITEMS DESIRED MARK "X"	MAXIMUM POSSESSION LIMITS (in curies)
Group I		As Needed	**IODINE-131** as iodide for treatment of hyperthyroidism		
Group II		As Needed	**PHOSPHORUS-32** as soluble phosphate for treatment of polycythemia vera, leukemia and bone metastases		
Group III		As Needed	**PHOSPHORUS-32** as colloidal chromic phosphate for intracavitary treatment of malignant effusions		
Group IV		As Needed	**IODINE-131** as iodide for treatment of thyroid carcinoma		
Group V		As Needed	**STRONTIUM-89** as chloride for treatment of pain from cancer metastases		
Group VI		As Needed	**SAMARIUM-153** for treatment of pain from cancer.		
XENON-133 as gas or gas in saline for blood flow studies and pulmonary function studies					
TECHNETIUM 99m – Aerosol		As Needed			

6b. RADIOACTIVE MATERIAL FOR USES NOT LISTED IN ITEM 6A. (Sealed Sources up to 3 mCi: used for calibration and reference standards are authorized under WAC 246-235-080 (3) (c) and up to 25 mCi for Cobalt –57 used for calibration and reference standards **NEED NOT BE LISTED.**

ELEMENT AND MASS NUMBER	CHEMICAL AND/OR PHYSICAL FORM	MAXIMUM NUMBER OF MILLICURIES OR BECQUERELS OF EACH FORM	DESCRIBE PURPOSE OF USE

INFORMATION REQUIRED FOR ITEMS 7 THROUGH 29

For Items 7 through 30, check the appropriate box(es) and submit a detailed description of all the requested information. Submit signed and dated "ready made" attachments or your equivalent procedures. Begin each item on a separate sheet. Any electronic modifications to this ready made" application (other than in format, typographical corrections or minor editing) must be made clearly evident to the reviewer.

7. **RADIATION SAFETY COMMITTEE**
(check one or more)
❑ Names and Specialties Attached; and
❑ Duties as in Attachment "A". or
❑ Equivalent Duties Attached

8. **RADIATION SAFETY OFFICER**
(check one)
❑ Duties as in Attachment "B", or
❑ Equivalent Duties Attached

9. **TRAINING AND EXPERIENCE**
(check one or more)
❑ Form RHF-2 completed for each individual user and/or RSO (RSO complete only parts 1, 4 & 9)
❑ Accepted Certification Attached for each individual user and/or RSO
❑ Individual user and/or RSO named in another license (license and license number attached)

10. **INSTRUMENTATION**
(check one)
❑ Attachment "C" attached, or
❑ Equivalent list attached
(list by name & model number)

11. **CALIBRATION OF INSTRUMENTS**
(check two)
❑ Attachment "D" Procedures Attached for survey instruments, or
❑ Equivalent Procedures Attached; and
(check one)
❑ Attachment "D" Procedures Attached for Dose calibrator; or
❑ Equivalent Procedures Attached

12. **FACILITIES AND EQUIPMENT**
❑ Description Attached
❑ Diagram Attached

13. **PERSONNEL TRAINING PROGRAM**
(check one)
❑ Attachment "E" Procedures Attached for Training, or
❑ Equivalent Procedures Attached

14. **PROCEDURES FOR ORDERING AND RECEIVING RADIOACTIVE MATERIAL**
(check one)
❑ Attachment "F" Procedures Attached, or
❑ Equivalent Procedures Attached

15. **PROCEDURES FOR OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL**
(check one)
❑ Attachment "G" Procedures Attached, or
❑ Equivalent Procedures Attached

16. **GENERAL RULES FOR THE SAFE USE OF RADIOACTIVE MATERIAL**
(check one)
❑ Attachment "H" Procedures Attached, or
❑ Equivalent Procedures Attached

17. **EMERGENCY PROCEDURES**
(check one)
❑ Attachment "I" Procedures Attached or
❑ Equivalent Procedures Attached

18. **AREA SURVEY PROCEDURES**
(check one)
❑ Attachment "J" Procedures Attached or
❑ Equivalent Procedures Attached

19. **WASTE DISPOSAL/STORAGE**
(check one)
❑ Attachment "K" Procedures Attached or
❑ Equivalent Procedures Attached

20. **THERAPEUTIC USE OF RADIOPHARMACEUTICALS**
(check one)
❑ Attachment "L" Procedures Attached or
❑ Equivalent Procedures Attached
❑ No therapeutic use of radio pharmaceuticals

21. **THERAPEUTIC USE OF SEALED SOURCES**
(check one or more)
❑ Detailed Information Attached, and
(check one)
❑ Attachment "M" Procedures Attached or
❑ Equivalent Procedures Attached, or
❑ No therapeutic use of sealed sources

22. **RADIOACTIVE GAXES & AEROSOLS**
(e.g.,XENON-133) (check one)
❑ Attachment "N" Attached, or
❑ Equivalent Supporting Information and Calculations Attached
❑ No XENON-133 use
❑ No aerosol use

23. **PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL IN ANIMALS**
(check one)
❑ Detailed Information Attached
❑ No radioactive materials used in animals.

24. **PROCEDURES AND PRECAUTIONS FOR USE OF RADIOACTIVE MATERIAL SPECIFIED IN ITEM 6b.**
❑ Detailed Information Attached

25. **PERSONNEL MONITORING, BIOASSAY, AND LEAK TEST PROGRAMS**
(check one)
❑ Attachment "O" Procedures Attached, or
❑ Equivalent Detailed Information Attached.

26. **PRIVATE PRACTICE APPLICANT PROGRAM**
❑ Detailed Information Attached

27. **"ALARA" PROGRAM** (Radiation Levels As Low As Reasonably Achievable)
(check one)
❑ Attachment "P" Procedures Attached or
❑ Equivalent Program Attached

28. **QUALITY MANAGEMENT PROGRAM**
❑ Attached
❑ Not Applicable

29. **LICENSE FEE REQUIRED**
(See WAC 246-254-080)
a. License Fee Category #_____
b. License Fee Enclosed: □

30. **LIABILITY INDEMNIFICATION CERTIFICATE**
❑ Attached
❑ Not Attached

31. The applicant and any official executing this certificate on behalf of the applicant named in Item 1, certify that this application is prepared in conformity with Washington State Department of Health, Division of Radiation Protection regulations and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief. All deviations from the department's standard application have been clearly identified.

_____ By: _____
(Type or Print Name of Certifying Official) (Signature)

_____ Date:_____
(Title of Certifying Official)

APPLICTION FOR
RADIOACTIVE MATERIAL LICENSE ~ MEDICAL

AUTHORIZED USE											
NAME OF AUTHORIZED USER	GROUP						Xe	Therapy Seeds	IVB	AEROSOL	OTHER ITEMS
	I	II	III	IV	V	VI					

APPLICTION FOR
RADIOACTIVE MATERIAL LICENSE ~ MEDICAL

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER

1. Name of authorized user or Radiation Safety Officer	2. State or Territory in which licensed to practice medicine

3. CERTIFICATION

SPECIALTY BOARD A	CATEGORY B	MONTH AND YEAR CERTIFIED C

4. TRAINING RECEIVED IN BASIC RADIONUCLIDE HANDLING TECHNIQUES

		TYPE AND LENGTH OF TRAINING	
FIELD OF TRAINING A	LOCATION AND DATE(S) OF TRAINING B	LECTURE/ LABORATORY COURSES (Hours) C	SUPERVISED LABORATORY EXPERIENCE (Hours) D
a. RADIATION PHYSICS AND INSTRUMENTATION			
b. RADIATION PROTECTION			
c. MATHEMATICS PERTAINING TO THE USE AND MEASUREMENT OF RADIOACTIVITY			
d. RADIATION BIOLOGY			
e. RADIOPHARMACEUTICAL CHEMISTRY			

5. EXPERIENCE WITH RADIATION (Actual use of Radionuclides)

NUCLIDES	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE

PRECEPTOR STATEMENT

Statement must be completed by the applicant physician's preceptor. If more than one preceptor is necessary to document experience, obtain a separate statement from each

1. APPLICANT'S/PHYSICIAN'S NAME AND ADDRESS (print/type)

_____
Full name

_____
Street Address

_____
City State Zip Code

KEY TO COLUMN C
PERSONAL PARTICIPATION SOULD CONSIST OF:

1. Supervised examination of patients to determine the suitability for radionuclide diagnosis and/or treatment and recommendation for prescribed dosage.

2. Collaboration in dose calibration and **actual administration** of dose to the patient including calculation of the radiation dose, related measurements and plotting of data.

3. Adequate period of training to enable physician to manage radioactive patients and follow patients through diagnosis and/or course of treatment.

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN

NUCLIDE **A**	**CONDITIONS DIAGNOSED OR TREATED** **B**	**NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION** **C**	**COMMENTS** (Additional information or comments may be submitted in duplicate on separate sheets.) **D**
I-131 OR I-125	DIAGNOSIS OF THYROID FUNCTION		
	DETERMINATION OF BLOOD AND BLOOD PLASMA VOLUME		
	LIVER FUNCTION STUDIES		
	FAT ABSORPTION STUDIES		
	KIDNEY FUNCTION STUDIES		
	IN-VITRO STUDIES		
OTHER			
I-125	DETECTION OF THROMBOSIS		
I-131	THYROID IMAGING		
P-32	EYE TUMOR LOCALIZATION		
SE-75	PANCREAS IMAGING		
YB-169	CISTERNOGRAPHY		
XE-133	BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES		
AEROSOL	PULMONARY FUNCTION STUDIES		
Tc-99m	BRAIN IMAGING		
	CARDIAC IMAGING		
	THYROID IMAGING		
	SALIVARY GLAND IMAGING		
	BLOOD POOL IMAGING		
	PLACENTAL LOCALIZATION		
	LIVER AND SPLEEN IMAGING		
	LUNG IMAGING		
	BONE IMAGING		
OTHER			

PRECEPTOR STATEMENT *(Continued)*

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN *(Continued)*

NUCLIDE **A**	**CONDITIONS DIAGNOSED OR TREATED** **B**	**NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION** **C**	**COMMENTS** (Additional information or comments may be submitted in duplicate on separate sheets.) **D**
P-32 (Soluble)	TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA, AND BONE METASTASES		
P-32 (Colloidal)	INTRACAVITARY TREATMENT		
P-32 (Sealed Source)	INTRALUMINAL TREATMENT		
I-131	TREATMENT OF THYROID CARCINOMA		
	TREATMENT OF HYPERTHYROIDISM		
Au-198	INTRACAVITARY TREATMENT		
Pd-103	INTERSTITIAL TREATMENT		
Co-60 or Cs-137	INTERSTITIAL TREATMENT		
	INTRACAVITARY TREATMENT		
I-125	INTERSTITIAL TREATMENT		
Ir-192	INTERSTITIAL TREATMENT		
	INTRALUMINAL TREATMENT		
	INTRACAVITARY TREATMENT		
	BRONCHIAL TREATMENT		
Co-60 or Cs-137	TELETHERAPY TREATMENT		
Sr-90	TREATMENT OF EYE DISEASE		
	INTRALUMINAL TREATMENT		
Sr-89	TREATMENT OF METASTATIC BONE PAIN		
Sm-153	TREATMENT OF METASTATIC BONE PAIN		
	RADIOPHARMACEUTICAL PREPARATION		
Mo-99/Tc99m	GENERATOR		
Sn-113/In-113m	GENERATOR		
Tc-99m	REAGENT KITS		
Other			

3. DATES AND TOTAL NUMBER OF HOURS RECEIVED IN CLINICAL RADIONUCLIDE TRAINING

4. THE TRAINING AND EXPERIENCE INDICATED ABOVE WAS OBTAINED UNDER THE SUPERVISION OF:

a. _____
Name of Supervisor (print or type

b. _____
Name of Institution

c. _____
Mailing Address

d. _____
City e. State f. Zip

6. Preceptor's Signature

_____

7. Preceptor's Name (Please type or print)

_____
Preceptor 's Phone Number and E-Mail Address

_____

8. Date

_____

5. Materials License Number(s) and Issuing Agency

Division of Radiation Protection
Washington State Department of Health

Medical Radioactive Materials License Application

Application Index

The following documents are contained in this radioactive materials license application. The first section forms the actual license application and the original must be returned to the Division of Radiation Protection in the same order as it appears here, and a copy remaining with you for your records.

I. RETURN THE FOLLOWING

Form RHF-1M – Application for Radioactive Material License – Medical

Form RHF-2 – Training and Experience, Authorized User or Radiation Safety Officer – Preceptor Statement (separately, for each one proposed).

M. Radiation Safety Procedures for Therapeutic Use of Sealed Sources. (NOTE: Teletherapy is addressed by separate forms, not included with this application.) 21

N. Radioactive Gases and Aerosols Supporting Information and Concentration Calculations 22

O. Personnel Monitoring, Bioassay and Sealed Source Leak Test Program 25

P. Model Program for Maintaining Occupational Radiation Exposures at Medical Institutions ALARA 27

Q. Quality Management Plan 28

II. **RETAIN THE FOLLOWING FOR YOUR RECORDS**

A. Reg. Guide 10.8 – Instructions for the Preparation of Applications for Medical Programs

B. Reg. Guide 8.20 – Bioassay Criteria for I-125 and I-131 (Appendix B)

C. At least one copy of this completed application, including all attachments.

ATTACHMENT A

RADIATION SAFETY COMMITTEE

Responsibility

The Committee is responsible for:

1. Ensuring that all individuals who work with or in the vicinity of radioactive material have sufficient training and experience to enable them to perform their duties safely and in accordance with state rules and regulations and conditions of license.

2. Ensuring that all use of radioactive material is conducted in a safe manner and in accordance with state rules and regulations and conditions of the license.

Duties

The Committee shall:

1. Be familiar with all pertinent regulations, the terms of the license, and information submitted in support of the request for the license and subsequent amendments.

2. Review the training and experience of all individuals who use radioactive materials (including physicians, technologists, physicists, and pharmacists) and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with regulations and conditions of the license.

3. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (e.g., nursing, security, and housekeeping personnel) are properly instructed as required by WAC 246-222-030 and conditions of the license.

4. Review and approve (subject to department restrictions) all requests for use of radioactive material within the institution prior to any such use.

5. Prescribe special conditions which will be required during a proposed use of radioactive material; e.g., requirements for bioassay, physical examinations of users, special monitoring procedures, etc.

6. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with state rules and regulations and the conditions of the license. The review shall be documented and include an examination of all records, procedures, equipment, reports from the Radiation Safety Officer, results of state inspections, written safety procedures, and the adequacy of the institution's management control system.

7. Recommend remedial action to correct any deficiencies identified in the radiation safety program.

8. Maintain written records of all committee meetings, actions, investigations, recommendations, and decisions.

9. Ensure that the radioactive materials license is amended when necessary, **prior** to any changes in facilities, equipment, policies, procedures, and personnel, as specified in the license.

ATTACHMENT A (Continued)

RADIATION SAFETY COMMITTEE

Meeting Frequency

The medical isotopes committee shall meet as often as necessary to conduct its business, but not less than once each calendar quarter.

Current Membership

Name	Specialty
	Radiation Safety Officer
	Nuclear Medicine Physician
	Nuclear Medicine Representative
	Administration
	Nursing
	Radiation Oncology
	Laboratory

Approved by: _____ Date: _____

ATTACHMENT B

DUTIES OF THE RADIATION SAFETY OFFICER

1. Be familiar with all applicable state and federal regulations and license application guides, and assure that license applications are properly filled out and are submitted on time. Make sure that the institutional radiation use and safety programs adhere to the license and license application conditions.

2. Establish and maintain record systems for all radiation area surveys, wipe tests, leak tests, calibration of instruments, and personnel dosimetry reports. Perform a documented quarterly review of records of radiation level surveys to determine that they are at ALARA levels during that period.

3. Advise individual radiation workers of each high dosimetry report, and conduct an investigation to determine the cause of each overexposure to preclude recurrence. Perform a documented quarterly review of occupational exposure to authorized users and workers to determine that the exposures are within the limits established for the ALARA program. Annually apprise, in writing, each radiation employee of annual accrued dose.

4. Assure that individuals working with radiation have appropriate protective devices, including shielding, ventilation, clothing, gloves, remote handling equipment (where necessary), instrumentation, and facilities which aid in keeping exposures As Low As Reasonably Achievable (ALARA).

5. Act as liaison agent with regulatory authorities, be available for assistance with inspections and audits, and notify the department:

   A. In writing **before** making any change which would render the Application for Radioactive Materials License or the Radioactive Materials License itself no longer accurate.

   B. **Immediately** in the event of any radiation accident or incident **(including high dosimeter reading).**

   C. Within five days of any positive leak test result of a sealed source.

   D. Within thirty (30) days in a report stating remedial action taken after accident or incident.

6. Perform, or cause to be performed, documented quarterly inventories of all sealed sources received or possessed. Make sure all surveys, calibrations, and leak tests are performed on time.

7. Post conspicuously “Notice to Employees” (Form RHF-3) and notices of items of noncompliance resulting from department inspections, as required.

8. Supply employers of terminated radiation personnel with radiation exposure records as required by regulation.

9. Establish, and cause to be maintained, inventory control of radionuclides at your institution, making sure inventory never exceeds amount licensed. Keep, or cause to be kept, records of receipts of incoming nuclides and survey of incoming and outgoing shipments. Make sure that all incoming and outgoing shipments are accompanied by proper shipping papers. Assure that radioactive materials are disposed of properly, and that records are maintained of all radioactive wastes disposed.

ATTACHMENT B (Continued)

DUTIES OF THE RADIATION SAFETY OFFICER

10. Perform a documented annual review of the radiation safety program for adherence to ALARA concepts. Make sure the safety program is followed by all workers dealing with radioactive material. Investigate any deviation from the program, and take any remedial action necessary.

11. Schedule briefings and educational sessions to inform workers of radiation safety rules and procedures:

    A. For all new personnel,

    B. With each change in license condition or safety program, and

    C. Annually in a refresher course for all appropriate personnel.

    This includes instruction in the ALARA program and philosophy.

12. Take charge in all emergency situations in the event of major or minor spills, or release of radioactive material, to make sure correct emergency decontamination and protection procedures are implemented. Evaluate the situation that led to the emergency, to reduce the chance of further problems.

13. Maintain, or cause to be maintained, written records of all Radiation Safety Committee meetings, actions, recommendations, and decisions.

Approved by: _____ Date:_____

ATTACHMENT C

INSTRUMENTATION

1. Survey meters: (Instruments generally required are a low-level survey meter for contamination surveys in CPM, and a high-level survey meter to measure radiation exposure rates in mR/hr in the vicinity of generators and therapeutic quantities of radioactive material.)

LOW-LEVEL/CONTAMINATION

A. Manufacturer's name _____

Instrument and probe(s) model(s) number(s) _____

Number of instruments available _____

Window thickness _____ mg/cm^2

Minimum range _____ CPM to _____ CPM

Maximum range _____ CPM to _____ CPM

HIGH-LEVEL/DOSE RATE

B. Manufacturer's name _____

Instrument and probe(s) model(s) number(s): _____

Number of instruments available _____

Wall thickness _____ mg/Cm^2

Minimum range _____ mR/hr to _____ mR/hr

Maximum range _____ mR/hr to _____ mR/hr to _____ R/hr

2. **Dose calibrator**

Manufacturer's name & model number _____

Number of instruments available _____

3. **Instruments used for diagnostic procedures (**gamma camera, uptake monitoring equipment, etc.)

Type of Instrument	Manufacturer's Name	Model No.
_____	_____	_____
_____	_____	_____

4. **Other** (e.g., liquid scintillation counter, area monitor, velometer)

_____

Approved by: _____ Date: _____

ATTACHMENT D

Section 1

CALIBRATION OF EXPOSURE RATE AND CONTAMINATION INSTRUMENTS (DOES NOT INCLUDE POCKET DOSIMETERS OR CHIRPERS)

1. Calibration of survey meters shall be performed with radionuclide sources.

   A. The sources shall approximate point sources for dose rate instruments and planchet sources for beta detectors.

   B. The source activities, exposure rates, or beta emission rates at given distances shall be traceable by documented measurements to a standard source certified within five percent accuracy by the National Institute of Standards and Technology (formerly NBS).

   C. The frequency shall be at least every 12 months and after servicing.

   D. Each scale of the instrument shall be calibrated for at least at two points located at approximately 1/3 and 2/3 of full scale.

   E. The exposure rate (mR/hr) for dose rate instruments measured by the instrument shall differ from the true exposure rate by less than 10 percent at the two points on each scale (read appropriate section of the instrument manual to determine how to make necessary adjustments to bring instrument into calibration). Readings within $\pm$ 20 percent will be considered acceptable if a calibration chart, graph, or response factor is prepared, attached to the instrument, and used to interpret meter readings to within 10 percent accuracy for radiation protection purposes.

      Beta efficiency determination shall be used for calibration of contamination survey instruments.

   F. Records of required calibrations shall be maintained for inspection for a period of at least two years from the date of calibration.

   NOTE:

   Sources of Cs-137, Ra-226, or Co-60 * are appropriate for use in dose rate calibrations. Since these sources emit rather high-energy photons, they are not suitable for low-energy or beta efficiency calibrations which may be required under special circumstances (see Item 3 below). The activity of the calibration standard should be sufficient to calibrate the survey meter on each scale to be used for radiation protection purposes. Scales up to 1 R/hr should be calibrated, but higher-range scales above 1 R/hr need not be calibrated when they will not be needed for radiation protection surveys. If there are higher ranges, they should at least be checked for operation and approximately correct response to radiation. Otherwise, a cautionary note that they have not been checked should be placed on the instrument.

   These procedures and standards are not appropriate for instruments used to detect or quantify measurements in the I-125 (approximately 30 KeV) energy range.

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* Minimum activities of typical dose rate sources are 85 mCi of Cs-137, 21 mCi of Co-60, or 3-4 mCi of Ra-226 (to give at least 700 mR/hr at 20 cm).

CALIBRATION OF EXPOSURE RATE AND CONTAMINATION INSTRUMENTS (DOES NOT INCLUDE POCKET DOSIMETERS OR CHIRPERS)

2. A reference check source of long half-life, e.g., Cs-137 or Ra-226, shall also be read at the time of the above calibration or as soon as the instrument is received from a calibration laboratory. The readings shall be taken with the check source placed in specific geometry relative to the detector. A reading of this reference check source shall be taken:

   A. Before each use and also after each survey to ensure that the instrument was operational during the survey.

   B. After each maintenance and/or battery change.

   C. At least every three months.

   If any reading using the same geometry is not within ± 20 percent of the reading measured immediately after calibration, the instrument must be recalibrated immediately (see Item 1).

3. Calibration source energies must correspond to energies of radioactive materials to be detected if instrument response is energy dependent, and if the instrument is to be used for quantitative measurements in the Xe-133 or Tc-99m energy ranges.

   The calibration may be done either:

   A. As in Item 1 above, with NIST-traceable calibration standards of radionuclides at or near the desired energies, or

   B. As a relative intercomparison with an energy-independent instrument and unassumed or uncertified radionuclides.

   Alternatively, the manufacturer's energy response curve(s) may be used to correct instrument readings appropriately when lower-energy radiation is monitored.

4. Records of the above Items shall be maintained for inspection.

5. Use of Inverse Square Law and Radioactive Decay Law

   A. An approved calibration source will have a calibration certificate giving its exposure or beta emission rate at a given distance, or its activity, measured on a specified date by the manufacturer or NIST.

      (1). The Inverse Square Law may be used with any point source to calculate the exposure rate at other distances.

      (2). The Radioactive Decay Law may be used to calculate the exposure rates or source activities at times other than the calibration date.

CALIBRATION OF EXPOSURE RATE AND CONTAMINATION INSTRUMENTS (DOES NOT INCLUDE POCKET DOSIMETERS OR CHIRPERS)

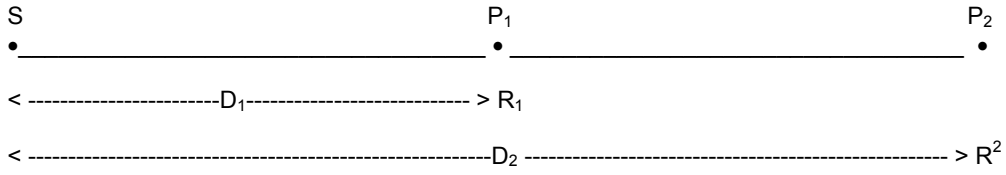
B. Inverse Square Law For Dose Rate Calibrations

Consider a "point" * source of radiation at position S, as shown in Figure D-1. Then, the relationship between exposure rates R_1 and R_2 at detector positions P_1 and P_2, which are at distances D_1 and D_2 and S, respectively is given by the following equation:

$$R_2 = \frac{D_1^2 \times R_1}{D_2^2}$$

Where R1 and R2 are exposure rates in the same units (e.g., mR/hr, R/hr) and D1 and D2 are the distances in Figure D-1 in the same units (e.g., m, cm, ft).

FIGURE D-1



C. Radioactive Decay Law

Exposure rate "t" units of time after specified calibration date

$$R_t = R_o \times e^{-\left(\frac{0.693}{T_{½}}\right) \times t}$$

Where

$R_{0 \text{ and } R_t}$ are in the same units (e.g., mR/hr or R/hr)

R_0 is exposure rate on the specified calibration date.

R_t is exposure rate t units of time later

$T_{1/2}$ and t are in the same units (years, months, days, etc.)

$T_{1/2}$ is the radionuclide half-life.

t is number of units of time elapsed between calibration and present time.

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* A Source may be considered a "point" source when the source and the radiation detector are small, in any dimension, compared to the distances at which radiation is to be measured. The center of the detector should be at distances D_1 or D_2 as shown in Figure D-1

CALIBRATION OF EXPOSURE RATE AND CONTAMINATION INSTRUMENTS (DOES NOT INCLUDE POCKET DOSIMETERS OR CHIRPERS)

D. **Example** Source output is given by calibration certificates as 100 mR/hr at 1 foot on March 10, 1975. Radionuclide half-life is 5.27 years.

Questions What is the output at 3 feet on March 10, 1977 (2.0 years later)?

(1). Output at 1 foot, 2.0 years after calibration date:

$$R = 100 \text{ mR/hr} \times e^{-\frac{(0.693 \times 2.0)}{5.27}}$$

$$= 100 \times 0.77 = 77 \text{ mR/hr at 1 foot on March 10, 1977.}$$

(2). Output at 3 feet, 2.0 years after calibration date:

$$R_3 = \frac{(1 \text{ ft})^2}{(3 \text{ ft})^2} \times 77 \text{mR/hr}$$

$$= 1/9 \times 77 = 8.6 \text{ mR/hr at 3 feet, 2.0 years after calibration.}$$

Approved by: _____ Date: _____

ATTACHMENT D (Continued)

CALIBRATION OF EXPOSURE RATE AND CONTAMINATION INSTRUMENTS (DOES NOT INCLUDE POCKET DOSIMETERS OR CHIRPERS)

CALIBRATION CHECK SHEET

Check appropriate items.

☐ 1. Survey instruments will be calibrated at least every 12 months and immediately following repair.

☐ 2. Calibration will be performed at two points on each scale used for radiation protection purposes; i.e., at least up to 1R/hr for dose rate.

The two points will be approximately 1/3 and 2/3 of full scale. A survey instrument may be considered properly calibrated when the instrument readings are within ± 10 percent of the calculated or known values for each point checked. Readings within ± 20 percent are considered acceptable if a calibration chart, graph, or response factor is prepared, attached to the instrument, and used to interpret readings to within ± 10 percent. Also, when higher scales are not checked or calibrated, an appropriate precautionary note will be posed on the instrument.

3. Survey instruments will be calibrated:

☐ A. By the manufacturer

☐ B. By the licensee

☐ (1) Calibration source(s)

Manufacturer's name _____

Model No. _____

Activity in millicuries _____

OR

Exposure rate at a specified distance _____

Accuracy _____

Traceability to primary standard _____

☐ (2) The calibration procedures in Attachment D, Section 1 will be used

OR

☐ (3) The step-by-step procedures, including radiation safety procedures, ate attached.

☐ C. By a consultant or outside firm.

(1) Name & License Number_____

(2) Address _____

(3) Phone Number _____E-Mail _____

SAMPLE FORM
"CERTIFICATE OF INSTRUMENT CALIBRATION"

Licensee Name _____

Instrument:

Manufacturer_____

Type_____

Model No._____

Serial No._____

Probe (if detachable):

Manufacturer_____

Type_____

Model No. _____

Serial No._____

Calibration Data:

Scale	Actual Exposure or Beta Emission Rate (mR/hr or CPM)	Initial Instrument Reading (mR/hr or CPM)	% Error	Adjusted Instrument Reading (mR/hr or CPM	Final % Error

Replace Batteries? □ Yes □ No

Comments:

Calibration Source:

Manufacturer/Model No._____ Serial No. _____

Nuclide _____ Accuracy _____ Original Activity/Date _____ / _____

Decay Factor _____ Current Activity _____

Exposure Rate at Specified Distance _____

CALIBRATED BY: _____ DATE: _____

Section 2

METHODS FOR CALIBRATION OF DOSE CALIBRATOR *

All Radiopharmaceuticals must be assayed for conformance of the activity to the prescribed dose to an accuracy of 10 percent. The most common instrument for accomplishing this is an ionization-type dose calibrator. The instrument must be checked for accurate operation at the time of installation and periodically thereafter.

1. **Test for the following:**

   A. Instrument constancy (daily)

   B. Instrument accuracy (upon installation and annually thereafter)

   C. Instrument linearity (upon installation and quarterly thereafter)

   D. Geometrical variation (upon installation and after repair)

2. After repair or adjustment of the dose calibrator, repeat all the appropriate tests listed above (depending upon the nature of the repairs).

3. Test for Instrument Constancy

Instrument constancy means that there is reproducibility, within a stated degree of precision, in measuring a constant activity over time. Assay at least one relatively long-lived reference source such as CS-137, Co-57, or Ra-226 using a reproducible geometry before each day's use of the instrument. Preferably, at least two reference sources (for example, 3-5 mCi (111-175 megabecquerels) of Co-57 and 100-200 μCi (3.7-7.4 megabecquerels) of Cs-137, or 1-2 mg (37-74 megabecquerels) Ra-226 (with appropriate decay corrections)) will be alternated each day of use to test the instrument's performance over a range of photon energies and source activities.

   A. Assay each reference source using the appropriate instrument setting (i.e., Cs-137 setting for Cs-137).

   B. Measure background level at same instrument setting, or check that automatic background subtraction is operating properly when blanks are inserted in the calibrator.

   C. Calculate net activity of each source, subtracting out background level.

   D. For each source, plot net activity versus the day of the year on semilog graph paper.

   E. Log the background levels.

   F. Indicate the predicted activity of each source based on decay calculations and the ± 5 percent limits on the graph.

   G. Repeat the procedure used for the Cs-137 source for all the commonly used radionuclide settings.

---

* See ANSI N42.13-1978 "Calibration and Usage of Dose Calibrator Ionization Chambers for the Assay of Radionuclides" (American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018).

METHODS FOR CALIBRATION OF DOSE CALIBRATOR (Continued)

H. Variations greater than ± 5 per cent from the predicted activity indicate the need for instrument repair or adjustment.

I. Investigate higher than normal background levels to determine their origin and to eliminate them if possible by decontamination, relocation, etc.

4. Inspect the instrument on a quarterly basis to ascertain that the measurement chamber liner is in place and that instrument zero is properly set (see Manufacturer's Instructions).

5. **Test of Instrument Linearity**

The linearity of a dose calibrator should be ascertained over the entire range of activities employed. This test will use a vial of Tc-99m whose activity is equivalent to the **maximum** anticipated activity to be assayed (**i.e., the first elution from a new generator or largest unit dose/multi-dose measured.)**

A. Assay the Tc-99m vial in the dose calibrator, and subtract background level to obtain net activity in millicuries or becquerels.

B. Repeat Step 1 at time intervals of 6, 24, 30, and 48 hours after the initial assay.

C. Using the 30-hour activity measurement as a starting point, calculate the predicted activities at 0, 6, 24, and 48 hours using the following table:

Assay Time* (hr)	Correction Factor
0	31.633
6	15.853
24	1.995
30	1
48	0.126

Example: If the net activity measured at 30 hours was 15.625 mCi (578.1 megabecquerels), the calculated activities for 6 and 48 hours would be 15.625 mCi x 15.853 = 247.7 mCi (9.165 gigabecquerels) and 15.625 mCi x 0.126 = 1.97 mCi (72.89 megabecquerels), respectively.

D. On log-log coordinate paper, plot the measured net activity (for each time interval) versus the calculated activity (for the same time interval),

E. The activities plotted should be within ± 5 percent of the calculated activity of the instrument is linear and functioning properly. (**ERRORS GREATER THAN ± 5 PERCENT INDICATE THE NEED FOR REPAIR OR ADJUSTMENT OF THE INSTRUMENT.)**

F. If instrument linearity cannot be corrected, it will be necessary in routine assays to use either

(1). an aliquot of the eluate that can be accurately measured, or

(2). the graph constructed in Step 4 to relate measured activities to calculated activities.

---

* Assay times should be measured in whole hours and correction factors should be used to the third decimal place as indicated. $T_{1/2} = 6.02$ hours has been used in calculating these correction factors.

6. Test for Geometrical Variation

There may be significant geometrical variation in activity measured as a function of sample volume or configuration, depending on the volume and size of the ionization chamber used in the dose calibrator. The extent of geometrical variation should be ascertained for commonly used radionuclides and appropriate correction factors computed if variations are significant, i.e., greater than $\pm$ 2 percent. (Even though correction factors may be provided by the manufacturer, the accuracy of these should be checked.) When available from the manufacturer, certified data on geometrical variations may be used in lieu of these measurements.

To measure variation with volume of liquid, a 30-cc vial containing 2 mCi (74 megabecquerels) of Co-57 or other appropriate radionuclide in a volume of 1 ml will be used.

A. Assay vial at the appropriate instrument setting, and subtract background level to obtain net activity.

B. Increase the volume of liquid in the vial by steps to 2, 4, 8, 10, 20, and 25 ml by adding the appropriate amount of water or saline. After each addition, gently shake the vial to mix the contents and assay as in Step 1. **(Follow good radiation safety practices to avoid contamination and to minimize radiation exposure.)**

C. Select one volume as a standard (such as the volume of reference standard used in performing the test for instrument accuracy), and calculate the ratio of measured activities for each volume to the reference volume activity. This represents the volume correction factor (**CF**).

Example: If activities of 2.04, 2.02 and 2.00 mCi are measured for 4, 8 and 10 ml volumes and 10 ml is the reference volume selected.

$$\textbf{4 ml Volume CF} = \frac{\textbf{2.00}}{\textbf{2.04}} = \textbf{0.98}$$

D. Plot the correction factors against the volume on linear graph paper. Use this graph to select the proper volume correction factors for routine assay of that radionuclide.

E. The true activity of sample is calculated as follows:

True Activity = Measured Activity x Correction Factor

Where the correction factor used is for the same volume and geometrical configuration as the sample measured.

F. Similarly, the same activity of Co-57 in a syringe may be compared with that of 10 ml in a 30-cc vial, and a correction factor may be calculated.

G. It should be noted that differences of 200 percent in dose calibrator readings between glass and plastic syringes have been observed for lower-energy radionuclides such as I-125, which should be assayed in a dose calibrator only if the reliability of such an assay can be established. Glass tubes and syringes may also vary enough in thickness to cause significant errors in assaying I-125. Hence, adequate correction factors must be established.

An alternative to providing syringe calibration factors is to simply assay the stock vial before and after filling the syringe. The activity in the syringe is then the difference in the two readings (with a volume correction, if significant).

7. **Test for Instrument Accuracy**

Check the accuracy of the dose calibrator for several radionuclides, including Cs-137, and Ba-133, using appropriate reference standards whose activities have been calibrated by comparisons with standard sources that have been assayed by NIST and documented.

The activity levels of the reference sources used should approximate those levels normally encountered in clinical use (e.g., Co-57, 3-5 millicuries/111-175 megabecquerels) giving adequate attention to source configuration. Identify in your application the three sources that you will use. State nuclide, activity, and calibration accuracy. The lower-energy reference standards (Tc-99m, Xe-133, I-125) must be in vials with the same thickness of glass as the actual samples, to be measured for the best accuracy.

A. Assay the reference standard in the dose calibrator at the appropriate setting, and subtract the background level to obtain the net activity.

B. Repeat Step 1 for a total of three (3) determinations, and then average the results.

C. The average activity determined in Step B should agree with the certified activity of the reference source within $\pm$ 5 percent after decay corrections.

D. Repeat the above steps for other commonly used radionuclides for which adequate reference standards are available.

E. Keep a log of these calibration checks.

F. **Calibration checks that do not agree within $\pm$ 5 percent indicate that the instrument should be repaired or adjusted.** If this is not possible, a calibration factor should be calculated for use during routing assays of radionuclides.

G. At the same time the instrument is being initially calibrated at the licensee's facility with the reference standards, place a long-lived source in the calibrator, set the instrument, in turn, to the various radionuclide settings used (Cs-137, I-131, Tc-99m, I-125, etc.) and record the readings. These values may later be used to check instrument calibration at each setting (after correcting for decay of the long-lived source) without requiring more reference standards. **Keep a log of these initial and subsequent readings.**

CALIBRATION OF DOSE CALIBRATOR

1. Sources Used for Linearity Test

   (Check as appropriate)

   ☐ **Entire** first elution from new Mo-99/Tc-99m generator

   OR

   ☐ Other * (specify) _____

2. Sources Used for Instrument Accuracy and Constancy Tests

Radionuclide	Suggested Activity in mCi	Activity	Accuracy
Co-57	3-5 (111-175 megabecquerels)	_____	_____
Ba-133	0.1-0.5 (3.7-18.5 megabecquerels)	_____	_____
Cs-137	0.1-0.2 (3.7-7.4 megabecquerels)	_____	_____
Ra-226	1-2 (37-74 megabecquerels)	_____	_____
_____ Other		_____	_____

3. ☐ The procedures described in Section 2 of Appendix D will be used for calibration of the dose calibrator.

   OR

   ☐ Equivalent procedures are attached.

_____

* For licensees who are not authorized for Mo-99/Tc-99m generators, activity must be equal to the highest activity assayed.

Section 3

DIAGNOSTIC INSTRUMENT CALIBRATION AND QUALITY CONTROL PROGRAM

INSTRUMENT	TEST/PROCEDURE	FREQUENCY
	Camera uniformity	Daily
	Camera resolution	Weekly
	Camera Center of rotation	Per Manufacturer

Approved By: _____ Date: _____

ATTACHMENT E

PERSONNEL TRAINING PROGRAM

1. The Radiation Safety Officer or (designee's title) _____ shall provide instruction to radiation workers prior to working with radioactive material. Instruction shall include, but is not limited to:

   A. General radioactive safety rules.

   B. Personnel monitoring program (e.g., use, exchange, storage, records, and reports).

   C. Radiation and contamination survey program.

   D. Accident, incident, and emergency procedures.

   E. Radioactive materials work procedures.

      (1) . Ordering, receipt, and opening procedures.

      (2). Storage.

      (3). Dispensing (including Molybdenum contamination tests for Molybdenum 99/Technetium 99m generators).

      (4). Administration.

      (5). Waste packaging and storage.

      (6). Transportation procedures.

   F. Applicable state and federal rules and regulations and license conditions.

2. The Radiation Safety Officer or (designee's title) _____ shall provide instruction to ancillary personnel, such as clerical, nursing, housekeeping, and security personnel, whose duties may require them to work in the vicinity of radioactive material. The instruction shall include, but not be limited to:

   A. All terms of the license pertinent to radiation safety.

   B. Identification of areas where radioactive material is used or stored.

   C. Potential hazards associated with radioactive material.

   D. Radiological safety procedures appropriate to their respective duties.

   E. Pertinent state and federal regulations.

   F. Rules and procedures of the license.

   G. Obligation to report unsafe conditions to the Radiation Safety Officer.

   H. Appropriate response to emergencies or unsafe conditions.

   I. Right to be informed of their radiation exposure and bioassay results.

PERSONNEL TRAINING PROGRAM

J. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by WAC 246-020.

The Radiation Safety Officer shall verify that personnel will be properly instructed before assuming duties with, or in the vicinity of, radioactive materials, during annual refresher training, and whenever there is a significant change in duties, regulations, or terms of the license.

Approved By: _____ Date: _____

ATTACHMENT F

PROCEDURES FOR ORDERING AND ACCEPTING DELIVERY OF RADIOACTIVE MATERIAL

1. The supervisory Nuclear Technologist will place all orders for radioactive materials and will ensure that the requested materials and quantities are authorized by the license and that possession limits are not exceeded.

2. A system for ordering and receiving radioactive materials will be established and maintained. The system will consist minimally of the following:

   A. Ordering of routinely used materials:

      (1) Written records that identify the nuclide, compound, activity levels, and supplier, etc., will be used.

      (2) The written records will be referenced when opening or storing radioactive shipments.

   B. Ordering of specially used materials (e.g., therapeutic doses)

      (1) A written request * will be obtained from the physicians who will perform the procedure.

      (2) Persons ordering the materials will reference the authorized user's written request when placing the order. The physician's request will indicate nuclide, compound, activity level, etc.

      (3) The physician's written request will be referenced when receiving, opening, or storing the radioactive material.

   C. Written records will be maintained for all ordering and receipt.

3. During normal working hours, carriers will be instructed to deliver radioactive packages directly to the Nuclear Medicine Department.

4. During off-duty hours, security personnel or other designated individuals will accept delivery of packages containing radioactive material in accordance with the procedures outlined in the sample memorandum on the following page.

---

* In the case of special orders, the physician's written request and appropriate shipping/receipt records will be referenced and the dose assayed prior to administration.

SAMPLE * MEMORANDUM

"PACKAGE RECEIPT"

TO: Security personnel _____

FROM: Administrator _____

SUBJECT: RECEIPT OF PACKAGES CONTAINING RADIOACTIVE MATERIAL

Any packages containing radioactive material that arrive between 4:30 p.m. and 7:00 a.m. or on Sundays shall be signed for by the security guard on duty and be taken immediately to the Nuclear Medicine Department. Unlock the door, place the package **on top of the counter immediately to the right of the door,** and relock the door.

IF THE PACKAGE IS WET OR APPEARS TO BE DAMAGED, **immediately** contact the hospital Radiation Safety Officer. Ask the carrier to remain at the hospital until it can be determined that neither the driver nor the delivery vehicle is contaminated.

RADIATION SAFETY OFFICER: _____

OFFICE PHONE: _____

HOME PHONE: _____

APPROVED BY: _____ DATE: _____

_____

* Submit a copy of your own facility's memorandum, revised, as appropriate.

ATTACHMENT G

PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL

1. Special requirements will be followed for packages containing quantities of radioactive material in excess of the Type A quantity limits specified in WAC 246-221-160 (more than 20 Ci/740 gigabecquerels) for Mo-99 and Tc-99m). They will be monitored for surface contamination and external radiation levels within three hours of receipt if received u\during working hours, or within 18 hours if received after working hours, in accordance with the requirements of WAC 246-221-160 **All shipments of liquids greater than exempt quantities will be tested for leakage.** The department will be notified in accordance wit the regulations if removable contamination exceeds 0.01 μCi or 370 becquerels per 100 cm^2, or if external radiation levels exceed 200 mR/hr at the package surface or 10 mR/hr at 3 feet (or 1m).

2. **FOR ALL PACKAGES, the following additional procedures for opening packages will be carried out.**

   A. **Put on gloves to prevent hand contamination.**

   B. **Visually inspect package for any sign of damage (e.g., wetness, crushed). If damage is noted, stop procedure and notify Radiation Safety Officer.**

   C. Measure exposure rate at 3 feet (or 1m) from package surface and **record.** If reading is greater than 10-mR/hr, stop procedure and notify Radiation Safety Officer.

   D. Measure surface exposure rate and **record.** If reading is greater than 200 mR/hr, stop procedure and notify Radiation Safety Officer.

   E. Open the package with the following precautionary steps:

      (1) Open the outer package (following manufacturer's directions, if supplied) and remove packing slip.

      (2) Open inner package and verify that contents agree with those on packing slip. Compare requisition,* packing slip, and label on container.

      (3) Check integrity of final source container (i.e., inspect for breakage of seals or vials, loss of liquid, and discoloration of packaging material).

      (4) Check also that shipment does not exceed possession limits.

   F. Wipe external surface of final source container and remove wipe to low background area. Assay the wipe and record amount of removable radioactivity (e.g., μCi or Bq/100 cm^2, etc.). Check wipes with a thin end-window or pancake G-M survey meter, and take precautions against the spread of contamination as necessary.

---

* In the case of special order, also compare with authorized user's written request.

PROCEDURES FOR SAFELY OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL (Continued)

G. Monitor the packing material and packages for contamination before discarding.

(1) If contaminated, treat as radioactive waste.

(2) If not contaminated, obliterate or remove radiation labels before discarding in regular trash.

(3). Maintain records of the results of checking each package, using “Radioactive Shipment Receipt Record” (see next page) or a form containing the same information.

Approved by: _____ Date: _____

Attachment G (Continued)
SAMPLE

"RADIOACTIVE PACKAGE RECEIPT RECORD"

1. P.O. No. _____ Survey Date _____ Time: _____

   Surveyor _____

   Survey Instrument, serial #, and most recent calibration date _____

2. **Condition of Package**

   □ O.K. □ Punctured □ Wet □ Crushed

   □ (Other)

3. Radiation Units of Label (T.I.): _____(mR/hr)

4. Label: □ White-I □ Yellow-II □ Yellow-III

5. **Measured Radiation Levels**

   A. Package surface _____mR/hr

   B. 3 feet or 1 meter from surface _____mR/hr

6. Do packing slip and vial contents agree?

   A. Radionuclide _____ yes _____ no, difference _____

   B. Amount____ _____ yes _____ no, difference _____

   C. Chem Form _____ yes _____ no, difference _____

7. **Wipe results**

   A. Outer _____ NET CPM (x EFF:_____) = _____DPM

   B. Final source contained _____ NET CPM (x EFF:_____) = _____DPM

8. Survey results of packing material and cartons _____CPM

   Background is _____ CPM

9. Disposition of package after inspection _____

10. If department/carrier notification required, give time, date and persons notified.

Approved By: _____ Date: _____

ATTACHMENT H

GENERAL RULES FOR SAFE USE OF RADIOACTIVE MATERIAL

Check appropriate boxes which apply to, and will be used at, your facility.

☐ 1. Wear laboratory coats or other protective clothing at all times in areas where dispersible radioactive materials are used.

☐ 2. Wear disposable gloves at all times while handling dispersible radioactive materials.

☐ 3. Monitor hands and clothing for contamination after each procedure or before leaving the immediate area.

☐ 4. Always use syringe shields for routine preparation of patient doses and administration to patients, except in circumstances, such as pediatric cases, when their use would compromise the patient's well-being. In these cases, use other protective methods such as remote delivery of the dose (e.g., through use of a butterfly valve).

☐ 5. A. Do not eat, drink, smoke, chew, or apply cosmetics in any area where radioactive material is stored or used.

B. Do not store food, drink, or personal effects with radioactive material (e.g., in refrigerator).

☐ 6. A. Assay each patient dose in the dose calibrator prior to administration. Do not use any doses which differ from the prescribed dose by more than 10 per cent. **Note:** Unit doses of beta-emitting radionuclides which have been assayed by the nuclear pharmacy within 12-hours prior to actual administration need only a copy of that pharmacy assay.

☐ B. For therapeutic doses, also check the patient's name, the radionuclide, the chemical form, and the activity versus the order written by the physician who will perform the procedure.

☐ 7. Wear personnel monitoring devices (film badge or TLD) at all times while in areas where radioactive materials are used or stored. These devices should be worn at chest or waist level (or on fingers). Extremity monitors (ring badges) should worn with the chip in the palm of the hand. Personnel monitoring devices when not being worn to monitor occupational exposure must be stored in a designated low-background area.

☐ 8. Wear extremity dosimetry during elution of generator, and preparation, assay, and injection of radiopharmaceuticals.

☐ 9. Dispose of radioactive waste only in specially designated drains or properly shielded and labeled receptacles.

☐ 10. Never pipette by mouth.

☐ 11. Survey laboratory work area for contamination after each procedure or at the end of the day. Decontaminate as necessary.

GENERAL RULES FOR SAFE USE OF RADIOACTIVE MATERIAL

□ 12. Confine radioactive solutions in covered containers plainly identified and labeled with name of compound, radionuclide, date, activity, and radiation level, as applicable.

□ 13. Always transport radioactive material in shielded containers.

Approved by: _____ Date: _____

ATTACHMENT I

EMERGENCY PROCEDURES

MINOR SPILLS

1. **Notify –** Notify persons in the area that a spill has occurred.

2. **Prevent the spread –** Cover the spill with absorbent paper.

3. **Clean up –** Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose in the radioactive waste container. Also insert into the plastic bag all other contaminated materials such as disposable gloves.

4. **Survey –** With a low-range, thin-window G-M survey meter, check the area around the spill, feet**,** hands, and clothing for contamination.

5. **Report –** Report incident to the Radiation Safety Officer.

MAJOR SPILLS

1. C**lear the area –** Notify all persons not involved in the spill to vacate the room.

2. **Prevent the spread –** Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all potentially contaminated personnel to prevent the spread.

3. **Shield the source –** If possible, the spill should be shielded, but only if it can be done without further contamination and without significantly increasing your radiation exposure.

4. **Close the room – Leave the room and lock the door(s) to prevent entry.**

5. **Call for help –** Notify the Radiation Safety Officer immediately.

6. **Personnel Decontamination -** Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water, then resurvey. Repeat as necessary.

   Radiation Safety Officer _____

   Office Phone _____

   Home Phone _____

LOSS, THEFT, FIRE, EXPLOSION, OR VEHICLE ACCIDENT

Follow the procedures outlined in the Washington State Department of Health Radiation Emergency Handbook. Principally this shall include:

1. **Secure the area around the accident. Keep unauthorized people away. Alert people in vicinity of the presence of radioactivity and a possible hazard.**

2. **Do not leave the site -** Send a helper or onlooker to notify the following:

   A. Radiation Safety Officer _____

      Work phone _____ Home phone _____

EMERGENCY PROCEDURES

B. Local Police _____

C. Local Fire Department, where applicable _____

3. The Radiation Safety Officer, in turn, must immediately notify the State of Washington, Radiation Emergency Response (206) 682-5327, which is

   (206) N-U-C-L-E-A-R

   and other local authorities as indicated.

4. The radiation worker should inform emergency workers of the radiation hazard possible existing, should help them keep the area secure, and should explain to the emergency personnel the location of the radioactive device or chemical and the extent of the possible hazard. **In no case should the radiation worker leave the site** until qualified experts arrive, unless, of course, the operator is seriously injured or incapacitated, and must be removed from the site by emergency personnel.

   Alternate names and telephone numbers designated by Radiation Safety Officer.

_____	_____
_____	_____
_____	_____
_____	_____

Approved by: _____ Date:_____

ATTACHMENT J

AREA SURVEY PROCEDURES

1. All elution, preparation, and injection areas will be surveyed daily with an appropriate low-range survey meter and decontaminated if necessary.*

2. Laboratory areas where only small quantities of radioactive material are used (less than 100 μCi/7.4 megabecquerels) will be surveyed monthly.

3. Waste storage areas and all other laboratory areas will be surveyed weekly.

4. The weekly and monthly surveys will consist of:

   A. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.05 mR/hr.

   B. A series of wipe tests to measure contamination levels. The method for performing wipe tests will be sufficiently sensitive to detect 1000 dpm per 100 cm^2 for the contaminant involved. Wipes of elution and preparation areas or other "high background" areas will be removed to a low background area for measurement.

5. A permanent record will be kept of **all** survey results, **including negative results.** The record will include:

   A. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.05 mR/hr (for weekly surveys).

   B. Daily contamination survey results in CPM or DPM.

   C. Clearly legible, name of person conducting the survey.

   D. Drawing of the area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.

   E Measured exposure rates including background values, keyed to locations on drawing. Identification of survey meter(s) used by serial number, including probes, and date of most recent calibration.

   F. Corrective action taken in the case of contamination or excessive exposure rates, reduced contamination levels or exposure rates after corrective actions, and any appropriate comments.

6. Area will be cleaned if the contamination level exceeds 1000 dpm/200 cm^2.

* For daily surveys where no abnormal exposures are found, only the date, the identification of the person performing the survey, the identification of survey instrumentation used, and the survey results (including background) will be recorded.

Approved by: _____ Date:_____

ATTACHMENT K

WASTE STORAGE AND DISPOSAL

Note: Licensees are encouraged to reduce the volume of waste sent to shallow-land burial sites used by commercial waste disposal firms. Important steps in volume reduction are to segregate radioactive from non-radioactive waste, to hold short-lived radioactive waste for decay in storage, and to release certain materials into the sanitary sewer in accordance with WAC 246-221-190.

1. A. **Liquid waste** will be disposed (check as appropriate):

☐ In the sanitary sewerage system in accordance with WAC 246-221-190

☐ By commercial waste disposal service (see Item 1.D.). ******

☐ Other (specify):_____

B. **Mo-99/Tc-99m generators** will be (check as appropriate):

☐ Returned to the manufacturer for disposal.

☐ Held for decay ***** until radiation levels with all shielding removed, as measured in a low background area with a low-level survey meter, have reached background levels. All radiation labels will be removed or obliterated, and the waste will be disposed in normal trash. ******

☐ Disposed by commercial waste disposal service (see Item 4).*******

☐ No generator use is planned.

☐ Other (specify): _____

_____

_____

* Be sure waste storage areas are diagrammed and described in Item 12, and are surveyed as required by Attachment J.

** Generators may contain long-lived radioactive contaminants. Therefore, the generator columns will be segregated.

*** If US Ecology waste disposal site in Richland is to be used, a Washington State site use permit is required prior to disposal. (Call 360-407-7100, at the Washington State Department of Ecology, for application.)

ATTACHMENT K (Continued)

WASTE STORAGE AND DISPOSAL

C. **Other solid waste** will be (check as appropriate):

☐ Held for decay until radiation levels with all shielding removed, as measured in a low background area with a low-level survey meter, have reached background levels. All radiation labels will be removed or obliterated, and the waste will be disposed in normal trash.

☐ Disposed by commercial waste disposal service (see Item 1.D.). *** **(see page 38 for footnote)**

☐ Other (specify): _____

_____

D. The commercial waste disposal service used will be

_____
Name City, State

Radioactive Materials License No. _____

2. SANITARY SEWERAGE RADIOACTIVE MATERIAL DISPOSAL CONCENTRATION CALCULATION.

A. Determine total volume of sewerage per month: _____ ml.

(Note: The total volume of sewerage may be estimated by averaging the volume as stated on a sewerage bill or the volume of water used by a facility as stated on a water bill.)

Useful conversions: 1 cubic foot = 2.832 x 10^4 ml
1 gallon = 3.78 x 10^3 ml

B. Determine average activity for each nuclide disposed via the sanitary sewer per month.

	NUCLIDE	ACTIVITY (MICROCURIES OR BECQUERELS PER MONTH)
(1).	_____	_____
(2).	_____	_____
(3).	_____	_____
(4).	_____	_____
(5).	_____	_____

C. For each nuclide, divide the activity (microcuries or becquerels) by the monthly volume (ml)

	NUCLIDE	ACTIVITY/MONTH	VOLUME	=	AVERAGE MONTHLY CONCENTRATION
(1).	_____	_____ μCi or Bq/	_____ ml	=	_____ μCi or Bq-ml
(2).	_____	_____ μCi or Bq/	_____ ml	=	_____ μCi or Bq-ml
(3).	_____	_____ μCi or Bq/	_____ ml	=	_____ μCi or Bq-ml
(4).	_____	_____ μCi or Bq/	_____ ml	=	_____ μCi or Bq-ml
(5).	_____	_____ μCi or Bq/	_____ ml	=	_____ μCi or Bq-ml

D. To determine the compliance with regulations refer to WAC 246-221-190 and WAC 246-221-290, Appendix A.

Approved by: _____ Date: _____

ATTACHMENT L

RADIATION SAFETY PROCEDURES FOR THERAPEUTIC USE OF RADIOPHARMACEUTICALS

1. All patients treated with I-131 or P-32 will be placed in a private room that has a toilet. The large surfaces in the room and toilet area which are more likely to be contaminated will be covered with absorbent pads or protective material as appropriate to the amount of contamination to be expected. Special attention should be given to objects likely to be touched by the patient, e.g., telephones, doorknobs, and other items that are difficult to decontaminate. Plastic bags or wrappings that are waterproof and easily disposable should be used on the smaller items.

2. The patient's room will be properly posted or attended in accordance with WAC 246-221-120 and WAC 246-221-130.

3. Dose rate surveys of the patient's room **and surrounding areas** will be conducted as soon as practicable after administration of the treatment dose. Exposure rates will be measured at the patient's bedside, and 3 feet (1 m) from the patient and at the entrance to the room. If a movable shield is also used, measurements will be taken and recorded with and without the shield in place. The Radiation Safety Officer or his designee will then determine how long a person may remain at these positions and will post these times on the patient's chart and on their door. The results of daily surveys will be used to recalculate permitted times, which will be posted on the patient's chart and on their door.

4. The form "Nursing Instructions for Patients Treated with Iodine 131 or Phosphorus 32" (or a similar form containing all the requested information) will be completed **immediately after administration** of the treatment dose. A copy will be posted with or in the patient's chart.

5. Radiation levels in unrestricted areas will be maintained below the limits specified in WAC 246-221-060.

6. All linens will be surveyed for contamination before being removed from the patient's room and if necessary, will be held for decay.

7. Disposable plates, cups, eating utensils, tissue, surgical dressings, and other similar waste items will be placed in a specially designated and labeled container. The material will be collected **daily** by the Radiation Safety Officer or his designee, checked for contamination and contamination survey results recorded, and disposed as normal or radioactive waste, as appropriate.

8. Non-disposable items used for these patients will be held in plastic bags in the patient's room and will be checked for contamination by the Radiation Safety Officer or his designee. Items may be returned for normal use, held for decay, or decontaminated, as appropriate.

9. If urine or vomitus from therapy patients is collected, it will be stored for decay in the radioactive waste storage area. Such stored wastes will be retained until they have reached background levels as measured with a low-level survey meter. They will then be released to the sanitary sewerage system.

10. Before a therapy patient's room is reassigned to another patient, the room will be surveyed for contamination, decontaminated as necessary, all radioactive waste and waste containers removed, and documentation completed and maintained.

11. **Nursing Instructions**

A. Nurses should spend only that amount of time near the patient required for ordinary nursing care. Special restrictions may be noted on the precaution sheet on the patient's chart. Nurses should read these restrictions before administering to patients. **Call the Nuclear Medicine Department or the Radiation Safety Officer with any questions about the care of these patients.** Nursing personnel who attend the patient will wear personnel monitoring devices as advised by the Radiation Safety Officer or required by the license or regulations.

B. Visitors will be limited to those 18 years of age or over unless other instructions by the physician are noted on the precaution sheet on the patient's chart.

C. Patients must remain in bed while visitors are in the room, and visitors should remain at least 3 feet (and behind any shielding present) from the patient.

D. Patients containing radioactive material are to be confined to their rooms except for special medical or nursing purposes approved by the Nuclear Medicine Department or RSO.

E. **No nurse, visitor, or attendant who is pregnant or nursing shall be permitted in the room of a patient who has received a therapeutic amount of radioactivity until the patient no longer presents a radiation hazard. Female visitors should be asked whether they are pregnant or nursing.**

F. **Attending personnel** should wear rubber or disposable plastic gloves when handling urinals, bedpans, emesis basins, or other containers having any material obtained from the body of the patient. Wash gloves before removing and then wash hands. **Gloves should be left in the patient's room in the designated waste container.** These gloves need not be sterile or surgical in type.

G. **Disposable items** should be used in the care of these patients, whenever possible. These items hold be placed in the designed waste container. Contact the radiation Safety Officer of their designee for proper disposal of the contents of the designed waste container.

H. **All clothes and bed linens** used by the patient should be placed in the laundry bag provided and left in the patient's room to be checked by the Radiation Safety Officer of their designee.

I. **All non-disposable items** should be placed in a plastic bag and left in the patient's room to be checked by the Radiation Safety Officer or their designee.

J. **Surgical dressings** should be changed only as directed by the physician. Leaking from a puncture wound may stain the dressing dark red or purple. Such dressings should not be discarded but should be collected in plastic bags and turned over to the Radiation Safety Officer or their designee. Handle these dressings only with tongs or tweezers. Wear disposable gloves.

K. **FOR I-131 PATIENTS**

(1) The sanitary sewer will be used for disposal of patient excreta. The toilet should be flushed several (3 or 4) times after each use. If the patient is bedridden, a separate urinal or bedpan should be flushed several times with hot soapy water after each use.

(2) If the nurse helps to collect the excreta, disposable gloves should be worn. Afterward, hands should be washed with the gloves on and again after the gloves are removed. The gloves should be placed in the designated waste container for disposal by the Radiation Safety Officer or his designee.

(3) Patients treated with I-131 will use disposable plates, cups, and eating utensils.

(4) Vomiting within 24 hours after oral administration, urinary incontinence, or excessive sweating within the first 48 hours may result in contamination of linen and floor. **In any situation where the patient's room may be contaminated or if radioactive urine and/or feces is spilled, call the Radiation Safety Officer or their designee, telephone: _____ .** Meanwhile, handle all contaminated material with disposable gloves and avoid spreading contamination.

(5) Keep all contaminated wastes and vomitus in plastic bags in the patient's room for disposal by the Radiation Safety Officer or their designee. Feces need not be routinely saved unless ordered on the chart. The same toilet should be used by the patient at all times and should be well flushed (3 times,) after each use. The Radiation Safety Officer will establish procedures for disposal of wastes (see Item 12 below).

L. If a nurse, attendant, or anyone else knows or suspects that their skin or clothing, including shoes, is contaminated, notify the Radiation Safety Officer or his designee immediately. This person should not walk about the hospital. If the hands become contaminated, wash them immediately with soap and water.

M. If a therapy patient should need emergency surgery or should die, notify the Radiation Safety Officer of their designee or the Nuclear Medicine Department immediately.

N. When the patient is discharged, call the Radiation Safety Officer, or designee, or the Nuclear Medicine Department and request that the room be surveyed for contamination and released for use before re-making the room.

12. **WASTE DISPOSAL**

When contaminated wastes are transported to the Waste Storage/Disposal Area, precautions will be taken to minimize external irradiation of personnel. Stored wastes will be shielded to maintain exposure to personnel in restricted and unrestricted areas as low as reasonably achievable (ALARA).

Approved by: _____ Date: _____

NURSING INSTRUCTIONS FOR PATIENTS TREATED WITH PHOSPHORUS 32, IODINE 131, STRONTIUM 89, AND/OR SAMARIUM 153

Patient's Name _____

Room No. _____ Physician's Name _____

Radionuclide Administered _____

Location of Administration and Name of Actual Administrator _____

Date and Time of Administration _____

Dose Received _____ Method of Administration _____

Exposure Rates in mR/hr
(indicate shielded/unshielded status of measurements)

Date	Instrument Used (include serial number)	10 feet from bed	3 feet from bed	Bedside	Adjacent Rooms	Surveyor

COMPLY WITH ALL CHECKED ITEMS)

☐ 1. Visiting time permitted _____

☐ 2. Visitors must remain _____ feet from patient.

☐ 3. Patient may not leave room.

☐ 4. Visitors under 18 are not permitted.

☐ 5. Pregnant visitors are not permitted.

☐ 6. Personnel dosimetry must be worn.

☐ 7. Dosimetry will be worn for supplementary personnel monitoring of individual tasks.

☐ 8. Tag the following objects and fill out the tag

- ☐ Door
- ☐ Chart
- ☐ Bed
- ☐ Wrist

☐ 9. Place laundry in linen bag and save.

NURSING INSTRUCTIONS FOR PATIENTS TREATED WITH PHOSPHORUS 32, IODINE 131, STRONTIUM 89, AND/OR SAMARIUM 153

10. Housekeeping may not enter the room.
11. Patient must have a private room.
12. Disposable gloves must be worn while attending patient.
13. Patient must use disposable utensils.
14. All items must remain in room until approved for removal by the Radiation Safety Officer, or designee.
15. Smoking is not permitted.
16. Room is not to be released to Admitting Office until approved by the Radiation Safety Officer, or designee.
17. Other instructions.

IN CASE OF AN EMERGENCY CONTACT:

_____	_____	_____
Name of Radiation Safety Officer	ON-Duty	OFF-Duty
	Telephone Numbers	

Approved _____ Date: _____

ATTACHMENT M

RADIATION SAFETY PROCEDURES FOR THERAPEUTIC USE OF SEALED SOURCES *

1. All patients treated with temporary brachytherapy sources will be placed in a private room that has a private toilet.

2. The patient's room will be properly posted or attended in accordance with WAC 246-221-120 and WAC 246-221-130.

3. Documented dose rate surveys of the patient's room and surrounding areas will be conducted as soon as practicable after sources are implanted. Exposure rate measurements (indicate shielded/unshielded) will be taken at 3 feet (1m) from the patient with sources implanted, at the patient's bedside, at 3 feet (1m) from the bed, and at the entrance to the room. The Radiation Safety Officer, or designee will then determine how long a person may remain at these positions and will post these times and the exposure rate at 3 feet (1m) from the patient on the patient's chart.

4. Immediately after sources are implanted, the form "Nursing Instruction for Patients Treated with Brachytherapy Sources" will be completed and attached to the patient's chart.

5. Radiation levels in unrestricted areas will be maintained below the limits specified in WAC 246-221-060.

6. Nurses caring for brachytherapy patients will be assigned personnel dosimetry. Extremity monitoring will also be assigned to nurses who must provide extended personal care to the patient. Pocket dosimeters may be assigned **in addition** to other personnel dosimetry.

7. At the conclusion of treatment, a survey will be performed in accordance with paragraph WAC 246-240-020(3) (c) to insure that all sources other than permanent implants have been removed from the patient and that no sources remain in the patient's room or in any other area occupied by the patient. At the same time, all radiation signs will be removed and all dosimetry devices assigned to nurses will be collected. If the patient is to be discharged, the final survey will also include a notation on the patient's chart that the activity remaining in the patient meets conditions for release from the hospital.

8. **Instructions to Nurses**

   A. Special restrictions may be noted on the precaution sheet on the patient's chart. **Nurses should read these instructions before administering to the patient.** The Radiation Safety Officer should be contacted to answer any questions about the care of these patients in regard to radiation safety precautions.

   B. Nurses should spend only the minimum time necessary near a patient for routine nursing care. Obtain and wear appropriate dosimetry as instructed by the Radiation Safety Officer.

   C. When a nurse is assigned to a therapy patient, dosimetry should be obtained immediately from the Radiation Safety Officer, or designee. **Dosimetry shall be worn only by the nurse to whom it is issued and shall not be exchanged among nurses.**

   D. **Pregnant nurses should not be assigned to the personal care of these patients.**

---

* Be sure to submit complete responses to Items 21a through 21f in addition to referencing procedures in Attachment M.

RADIATION SAFETY PROCEDURES FOR THERAPEUTIC USE OF SEALED SOURCES

E. Never touch needles, capsules, or containers holding brachytherapy sources. If a source becomes dislodged, use long forceps and put in the far corner of the room or in the shielded container provided; contact Radiation Therapy, the Radiation Safety Officer, or the Nuclear Medicine Department at once.

F. Bed baths given by the nurse should be omitted while the sources are in place.

G. While perineal care is not given during gynecologic treatment the perineal pad may be changed when necessary unless orders to the contrary have been written.

H. Surgical dressings and bandages used to cover the area of needle insertion may be changed only by the attending physician or radiologist and MAY NOT BE DISCARDED until directed by the radiologist. Dressings should be kept in a basin until checked by the Radiation Safety Officer, or designee.

SPECIAL ORDERS WILL BE WRITTENN FOR ORAL HYGIENE FOR PATIENTS WITH ORAL IMPLANTS.

I. No special precautions are needed for sputum, urine, vomitus, stools, dishes, instruments, or utensils unless specifically ordered, **but** these items should be saved for a check with the radiation survey meter to ensure that no sources have been inadvertently displaced into them.

J. **All bed linens must be checked** with a radiation survey meter before being removed from the patient's room to ensure that no dislodged sources are present and inadvertently removed.

K. Patients must stay in bed unless orders to the contrary are written. In any event, patients must remain in their assigned rooms during the treatment period.

L. Visitors will be limited to those 18 years of age or over unless other instructions are noted on the precaution sheet on the patient's chart.

M. Visitors should sit at least 3 feet (1m) from the patient, behind any shielding present, and should remain no longer than the time specified on the form posted on the patient's door chart.

N. **No nurse, visitor, or attendee who is pregnant or nursing shall be permitted in the room of a patient while brachytherapy sources are implanted in the patient.** Female visitors should be asked whether they are pregnant or nursing.

O. **Emergency Procedures**

(1) If an implanted source becomes loose or separated from the patient, or

(2) If the patient dies, or

(3) If the patient requires emergency surgery, immediately call:

_____

_____

Telephone No. _____
(days) (nights)

RADIATION SAFETY PROCEDURES FOR THERAPEUTIC USE OF SEALED SOURCES

P. **At the conclusion of treatment, call the Radiation Safety Officer to:**

(1) **Survey the patient and room.**

(2) **Count the radiation sources** to be sure that all temporary implants have been removed prior to discharging the patient, and

(3) **Record a summary of the final survey results** on the patient's chart.

If any permanent implants are to remain in the patient, the Radiation Safety Officer will brief the patient on precautions for minimizing radiation exposure to others after discharge from the hospital.

Approved by: _____ Date: _____

Attachment M (continued)

NURSING INSTRUCTIONS FOR PATIENTS TREATED WITH BRACHYTHERAPY SOURCES

Patient's Name _____

Room No. _____ Physician's Name _____

Nuclide and Activity _____

Location of Administration _____

Actual Administration By _____

Date and Time of Administration _____

Exposure Rates in mR/hr
(indicate shielded/unshielded status of measurements)

Date	Instrument Used (include serial number)	10 feet from bed	3 feet from bed	Bedside	Adjacent Rooms	Surveyor

(COMPLY WITH ALL CHECKED ITEMS)

- ❑ 1. Visiting time permitted _____
- ❑ 2. Visitors must remain _____ feet from patient (and behind any shielding present)
- ❑ 3. Patient may not leave room.
- ❑ 4. Visitors under 18 are not permitted.
- ❑ 5. Pregnant or nursing visitors are not permitted.
- ❑ 6. Dosimetry must be worn.
- ❑ 7. Dosimetry will be worn for supplementary personnel monitoring of individual tasks.
- ❑ 8. Tag the following objects and fill out the tag
  - ❑ Door
  - ❑ Chart
  - ❑ Bed
  - ❑ Wrist
- ❑ 9. Place laundry in linen bag and save.

Attachment M (continued)

NURSING INSTRUCTIONS FOR PATIENTS TREATED WITH BRACHYTHERAPY SOURCES

- ❑ 10. Housekeeping may not enter the room.
- ❑ 11. Patient must have a private room.
- ❑ 12. Disposable gloves must be worn while attending patient.
- ❑ 13. All items must remain in room until approved for removal by the Radiation Safety Officer, or designee.
- ❑ 14. **A RELEASE SURVEY MUST BE PERFORMED AND DOCUMENTED BEFORE THE PATIENT IS DISCHARGED.**
- ❑ 15. Room is not to be released to Admitting Office until approved by the Radiation Safety Officer, or designee.
- ❑ 16. **Contact the Radiation Safety Officer when temporary sources (non-permanent implants) are removed** to perform a survey to be sure all sources are removed from the patient, to do a physical source count, and to be sure no sources remain in the room.
- ❑ 17. Other instructions.

IN CASE OF AN EMERGENCY CONTACT:

_____	_____	_____
Name of Radiation Safety Officer	ON-Duty	OFF-Duty
	Telephone Numbers	

Approved by: _____ Date: _____

ATTACHMENT N

RADIOACTIVE GASES AND AEROSOLS
SUPPORTING INFORMATION AND CONCENTRATION CALCULATIONS

1. **XENON 133**

A. **Definition Of Variables**

(1). Average number of studies expected per week: _____ = S.

(2). Average activity per patient dose: _____ = A.

(3). Desired possession limit: _____ mCi or Bq. (This should be sufficient to provide for shipments whose calibration dates are several days after receipt.)

(4). Loss rate fraction is assumed to be 0.20 = f = 20%.

(5). **Is use area under negative pressure?** ☐ Yes ☐ No

(6). Measured airflow exhaust rate from Xenon 133 storage and use area: _____ ft^3/min = r

(7). Measured airflow exhaust rate of air potentially contaminated with Xe-133 at point of release to unrestricted area (exterior of building): ft^3 /min - R

(If exhaust air from Xenon 133 use area is vented directly to roof of building without being mixed with additional exhaust air from building, R = r. If additional air is mixed in air from Xenon 133 use area, R will be greater than r.)

(8). Dilution factor of exhaust air $D = \frac{R}{r} =$ _____

Is the use area ventilated by a partially re-circulating building ventilation system?
☐ Yes ☐ No If yes, complete Item (9).

(9). The fraction of re-circulated air is _____ % = 0._____ = F

B. **Occupational Exposure Concentration (C)**

The average concentration in restricted area is:

$$C_r = \frac{S.A.f}{r} \bullet \frac{1000\ \mu Ci}{mCi} \bullet \frac{\_\_\_\_\_ ft^3/min \_\_\_\_\_}{6.797 \times 10^7\ ml/40\ hr\text{-}wk} = \frac{S.A}{r} \bullet 2.9424 \times 10^{-6} = \_\_\_\_\_ \frac{\mu Ci}{ml}$$

Calculated C_r should be less than 1×10^{-5} μCi/ml. If it is larger, the exhaust rate (r) must be increased, or the patient load (S) reduced.

If C_r is greater than 1×10^{-5} μCi/ml, and the hospital wants to keep the same patient load, the minimum exhaust rate from use area can be calculated as follows:

$$= S.A. \quad \frac{2.9424 \times 10^{-6}}{1 \times 10^{-5}} = S.A.\ 0.29424 = \_\_\_\_\_ \frac{ft^3}{min}$$

If ventilation system in use area is non-re-circulating, complete calculation C.

RADIOACTIVE GASES AND AEROSOLS
SUPPORTING INFORMATION AND CONCENTRATION CALCULATIONS

C. **Unrestricted Release Concentration (Exterior of the Building)**
The average concentration in unrestricted area at point of release is:

$$C_u = (C_r/D) \bullet \frac{40 \text{ hr-wk}}{168 \text{ hr-wk}} = (Cr/D) \quad 0.238 = \frac{\mu Ci}{\_\_\_\_\_ \text{ ml}}$$

C_u should be less than 3 x 10^{-7} μCi/ml for Xe-133, or 8 x 10^{-2} μCi/ml for Technetium 99m. If it is not, the exhaust rate R must be increased either by reducing (r) or the dilution factor (D), or the patient load S must be reduced.

If (S) is kept constant, the minimum necessary total exhaust rate (R) can be calculated as follows:

$$R = \text{S.A.} \bullet 3 \bullet 10^{-7} \text{ (Xe-133) or } 8 \bullet 10^{-2} \text{ (Tc-99m)} = \text{S.A.} \bullet \frac{2.9424 \times 10\text{-}6 \bullet 0.238}{(\text{Xe-133})} = \frac{ft^3}{\_\_\_\_\_ \text{ min.}}$$

D. **Facilities**

Submit facilities diagram presenting the following information:

(1). Use area.

(2). Storage location.

(3). Shielding.

(4). Proximity to unrestricted areas.

(5). Ventilation.

(a). Supply vents

(b). Exhaust vents

(c). Measured airflow rates of each vent.

(6). State fraction of air that is re-circulated.

(7). Describe any changes in flow rates that may exist between heating and cooling seasons.

(8). Describe the release point of the exhaust ventilation (e.g., controlled roof top).

(9). State the type and frequency (at least semiannually) of periodic measurements that you will make to determine that airflow rates are maintained as described.

ATTACHMENT N (Continued)

RADIOACTIVE GASES AND AEROSOLS
SUPPORTING INFORMATION AND CONCENTRATION CALCULATIONS

E. ADMINISTRATION APPARATUS

Manufacturer: _____

Model: _____

Design description: _____
_____
_____

F. **PROCEDURE FOR SAFE USE**

☐ The following use procedures shall be followed:

☐ Equivalent procedures are attached.

Storage

Xenon 133 will always be stored in a well ventilated space in shielded containers. Radiation surveys of storage areas will be done to ensure that radiation levels are adequately controlled.

Precautions

The following steps will be taken to minimize leakage and accidental losses:

(1). The ventilation system shall be operating.

(2). Nose clips will be used when a mouthpiece is used, and a mask whenever the patient is unable or unwilling to retain the mouthpiece.

(3). The patient will be allowed to breathe into the device for a few moments before the dose is administered so the patient will become used to it. **The dose shall not be administered if it appears the patient may panic and remove the mask or mouthpiece**.

(4). **No studies will be done if the ventilation system is down for repair or maintenance.**

(5). No more studies per week shall be performed than the patient load value found to be adequate in the preceding calculations.

Waste

Gas or aerosol is absorbed by organic materials especially rubber, so syringes, vials, tubing, etc., that may have contained gas or aerosol will be monitored and disposed as radioactive waste, if contaminated.

RADIOACTIVE GASES AND AEROSOLS
SUPPORTING INFORMATION AND CONCENTRATION CALCULATIONS

G. **EMERGENCY PROCEDURES**

☐ The following emergency procedures shall be followed.

☐ Equivalent emergency procedures are attached.

In the event a dose of gas or aerosol is released into the Imaging Room, the average concentration in the air will be many times the occupational exposure limit. The following action will be taken immediately:

(1). The technician shall take the patient out of the room immediately.

(2). The technician will shut and lock the door

(3). The technician will notify the Radiation Safety Officer.

(4). The technician will wait _____ minutes before re-entering the use area.

(5). The technician will then monitor the radiation level in the room. If it has returned to normal, it is safe to resume work.

H. **Disposal**

☐ Xenon will be disposed of by fume hood or exhaust vent to the exterior of the building (complete the following calculation).

Exhaust rate of fume hood or special vent at exterior of the building (including any dilution of other exhaust air) equals:

$$\_\_\_\_\_ \ \frac{ft^3}{min} = R$$

Patient load (S) and average dose activity per patient (A) are as defined in previous calculations.

$$C_u = \frac{S.A.}{R}$$

C_u must not exceed 3 x 10-7 mCi/ml. If it does, patient load (S) must be reduced, or ventilation rate (R) increased, or another method of disposal employed.

☐ Xenon will be disposed of by charcoal trap.

Trap manufacturer: _____

Model Number: _____ (inclusion of brochure would be helpful).

(1). The trap will be surveyed every week patients are examined.

(2). The manufacturer's specifications shall be followed in determining when trap is saturated.

(3). Trap filters will be disposed of in accordance with waste disposal procedures in Attachment K.

RADIOACTIVE GASES AND AEROSOLS
SUPPORTING INFORMATION AND CONCENTRATION CALCULATIONS

2. **AEROSOL**

   A. Tc-99m aerosol shall be administered utilizing an approved and shielded device.

   B. Tc-99m aerosol waste shall be collected in the approved, shielded trap and held for decay/disposal, as appropriate.

Approved by: _____ Date: _____

ATTACHMENT O

PERSONNEL MONITORING, BIOASSAY, AND SEALED SOURCE LEAK TEST PROGRAM

1. **Personnel Dosimetry**

   Supplier (Firm): _____

   Copy of NVLAP certification enclosed/attached: _____

   Type:

	Extremity	**Whole Body**
	❑ Beta-Gamma	❑ Beta-Gamma
	❑ Neutron	❑ Neutron
	❑ TLD	❑ TLD
	❑ Luxel	❑ Luxel

   Exchange frequency: ❑ Monthly ❑ WB ❑ Ext ❑ Quarterly ❑ WB ❑ Ext ❑ Every two weeks

   Results reviewed by: ❑ RSO ❑ RSC ❑ Consultant

   Records maintained by: _____

   Responsible for reports to personnel: _____
   (Annual and unusual and/or overexposure)

2. **Bioassay Program**

   Iodine Bioassay Program:

   ❑ **Will follow program as defined by Regulatory Guide 8.20.**

   Analysis performed by: (Consultant/Firm) _____

   If analysis in-house only, performed by: _____

   Instrumentation: _____Calibration Standard: _____

Attach: Sample procedures and dose calculations, sample of records maintained and report to personnel; records maintained by: _____

PERSONNEL MONITORING, BIOASSAY, AND SEALED SOURCE LEAK TEST PROGRAM

3. **Sealed Source Leak Test**

- ❑ Outside firm will provide entire leak test service.

  Authorized leak test service employed: _____

  Materials license number, issuing agency, and copy of NVLAP certification _____.

- ❑ Licensee will take wipe tests with approved leak test kit and have authorized firm analyze leak tests.

  Leak test kit manufacturer: _____

  Model number: _____

  Tests taken by: _____

  Tests analyzed by: _____

- ❑ Licensee will take and analyze own leak tests.

  Sampling material: _____

  Tests taken by: _____

  Analytical instrument: _____

Counting standard: Nuclide: _____ Activity: _____

Sample procedure(s) calculation, and record form (enclosed/attached):

Approved by:_____ Date: _____

ATTACHMENT P

MODEL PROGRAM FOR MAINTAINING OCCUPATIONAL RADIATION EXPOSURES AT MEDICAL INSTITUTIONS ALARA

_____
(Name of Licensee and License Number)

_____
(Date)

1. **Management Commitment**

   A. We, the management of this (medical facility, hospital, etc.) are committed to the program described in this paper for keeping exposures (individual and collective) **as low as is reasonably achievable (ALARA).** In accordance with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policies, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) ***** and a Radiation Safety Officer (RSO).

   B. We will perform a documented formal annual review of the radiation safety program, including ALARA considerations. This shall include reviews of operating procedures and past exposure records, inspections, etc., and consultations with the radiation protection staff or outside consultants.

   C. Modification to operating and maintenance procedures and to equipment and facilities will be made where they will reduce exposures unless the cost, in our judgment, is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented, or we will be prepared to describe the reasons for not implementing them.

   D. In addition to maintaining doses to individuals as far below the limit as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

2. **Radiation Safety Committee ****

   A. **Review of Proposed Users and Uses**

      (1). **The RSC will thoroughly review** the qualifications of each applicant with respect to the types and quantities of materials and uses for which they have applied, to ensure that the applicant will be able to take appropriate measures to maintain exposure ALARA.

      (2). When considering a new use of radioactive material, the RSC will review the efforts of the applicant to maintain exposure ALARA. The user should have systematized procedures to ensure ALARA and shall have incorporated the use of special equipment such as syringe shields, rubber gloves, etc., in the proposed use.

***** Private practice physician licensees do not include an RSC.

****** The RSO on private physician licenses will assume the responsibilities of the RSC under Section 2.

(3). **The RSC will ensure** that the user justifies their procedures and that doses will be ALARA (individual and collective),

B. **Delegation of Authority**

(The judicious delegation of RSC authority is essential to the enforcement of an ALARA program).

(1). **The RSC will delegate authority to the RSO** for enforcement of the ALARA concept.

(2). **The RSC will support the RSO** in those instances where it is necessary for the RSO to assert authority. Where the RSO has been overruled, the Committee will record the basis for its action in the minutes of the Committee's next meeting.

C. **Review of ALARA Program**

(1). **The RSC will encourage all users** to review current procedures and develop new procedures as appropriate to implement the ALARA concept.

(2). **The RSC will perform a documented quarterly review of occupational radiation exposure**, with particular attention to instances where Investigational Levels in Table P-1 (below) are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of ALARA program quality and to decide if action is warranted when Investigational Levels are exceeded (see Section 6).*

(3). **The RSC will evaluate and document our institution's overall efforts for maintaining exposures ALARA on an annual basis.** This review will include the efforts of the RSO, authorized users, and workers as well as those of management.

3. **Radiation Safety Officer (RSO)**

A. **Annual and Quarterly Review**

(1). **Annual review of the radiation safety program**. The RSO will perform a documented annual review of the radiation safety program for adherence to ALARA concepts. Review of specific procedures may be conducted on a more frequent basis.

(2). **Quarterly review of occupational exposures.** The RSO will review and document at least quarterly, the external radiation exposures of authorized users and workers to determine that their exposures are ALARA in accordance wit the provisions of Section 6 of this program.

(3). **Quarterly review of records of radiation level surveys.** The RSO will review and document radiation levels in unrestricted and restricted areas to determine that they were at ALARA levels during the previous quarter.

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B. **Education Responsibilities for ALARA Program**

(1). **The RSO will schedule** briefings and educational sessions to inform workers of ALARA program efforts.

(2). The RSO will ensure that authorized users, workers, and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that **management, the RSC, and the RSO are committed to implementing the ALARA concept.**

C. **Cooperative Efforts for Development of ALARA Procedures**

(1). The **RSO will be in close contact with all users and workers** in order to develop ALARA procedures for working with radioactive materials.

(2). The **RSO will establish and document procedures** for receiving and evaluating the suggestions of individual workers for improving health physics practices and will encourage the use of those procedures.

D. **Reviewing Instances of Deviation from Good ALARA practices.**

The RSO will document and investigate all known instances of deviation from good ALARA practices and, if possible, will determine the causes. When the cause is known, the RSO will require changes in the program to maintain exposures ALARA.

4. **Authorized Users**

A. New Procedures Involving Potential Radiation Exposures

(1). **The authorized user will consult with,** and receive the approval of, the RSO and/or RSC during the planning stage before using radioactive materials for a new procedure.

(2). **The authorized user will evaluate** all procedures before using radioactive materials to ensure that exposures will be kept ALARA. This may be enhanced through the application of trial runs.

B. Responsibility of Authorized User to Persons under Their Supervision.

(1). **The authorized user will explain the ALARA concept** and their commitment to maintain exposures ALARA to all persons under their supervision.

(2). **The authorized user will ensure** that persons under their supervision who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

5. **Persons Who Receive Occupational Radiation Exposure**

A. **The worker will be instructed** in the ALARA concept and its relationship to working procedures and work conditions.

B. **The worker shall be informed** of recourses that are available if they feel that ALARA is not being promoted on the job.

6. **Establishment of Investigational Levels** in order to monitor individual occupational external radiation exposures.

This institution (or private practice) hereby establishes Investigational Levels for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the RSC and/or the RSO. The Investigational Levels that we have adopted are listed in Table P-1 below. These levels apply to the exposure of individual workers.

Table P-1

INVESTIGATIONAL LEVELS
(MREMS PER CALENDAR QUARTER)

		Level I	Level II
(1).	Whole body; head and trunk, active blood-forming organs; lens of eyes; or gonads	125	375
(2).	Hands and forearms; feet, ankles	1875	5625
(3).	Skin of whole body *	750	2250

The Radiation Safety Officer will review and record on Form RHF-5, "Current Occupational External Radiation Exposures," or an equivalent form (e.g., dosimeter processor's report), results of personnel monitoring not less than once in any calendar quarter as required by WAC 246-221-230. The following actions will be taken at the Investigational Levels stated in Table P-1.

A. **Quarterly exposure of individuals to less than Investigational Level I.**

Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's exposure is less than Table P-1 values for the Investigation Level I.

B. **Personnel exposures equal to or greater than Investigational Level I, but less than Investigational Level II.**

The RSO will review the exposure of each individual whose quarterly exposure equals or exceeds Investigational Level I and will report the results of the review at the first RSC meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the Committee. The Committee will, however, consider each such exposure in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the Committee minutes.

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* Not normally applicable to nuclear medicine operations except those using significant quantities of beta-emitting nuclides.

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C. **Exposure equal to or greater than Investigational Level II.**

The RSO will investigate and document in a timely manner the cause(s) of all personnel exposures equaling or exceeding Investigational Level II and, if warranted, will take action. A report of the investigation, actions taken, if any, and a copy of the individual's Form RHF-5 or its equivalent will be presented to the RSC at the first RSC meeting following completion of the investigation. The details of these reports will be recorded in the RSC minutes. **Committee minutes will be sent to the management of this institution for review.** The minutes, containing details of the investigation, will be made available to department inspectors for review at the time of the next inspection.

D. **Reestablishment of an individual occupational worker's Investigational Level II to a level above that listed in Table P-1.**

In cases where a worker's, or a group of workers', exposures need to exceed Investigational Level II, a new, higher, Investigational Level II may be established on the basis that it is consistent with good ALARA practices for that individual or group. Justification for a new Investigational Level II will be documented.

The RSC will review the justification for, and must approve any revisions of, Investigational Level II. In such cases, when the exposure equals or exceeds the newly established Investigational Level II, those actions listed in Paragraph 6.C above will be followed.

7. **Signature of Certifying Official ***

I hereby certify that this institution (or private practice) has implemented and will maintain the ALARA Program set forth above.

_____

Signature Date

_____

Name (print or type)

_____

Title

_____

Institution (or private practice) Name and Address

_____

_____

* The person who is authorized to make commitments for the administration of the institution (e.g., hospital administrator) or, in the case of private practice, the licensed physician. In the case of a hospital or clinic, this is usually not the RSO.